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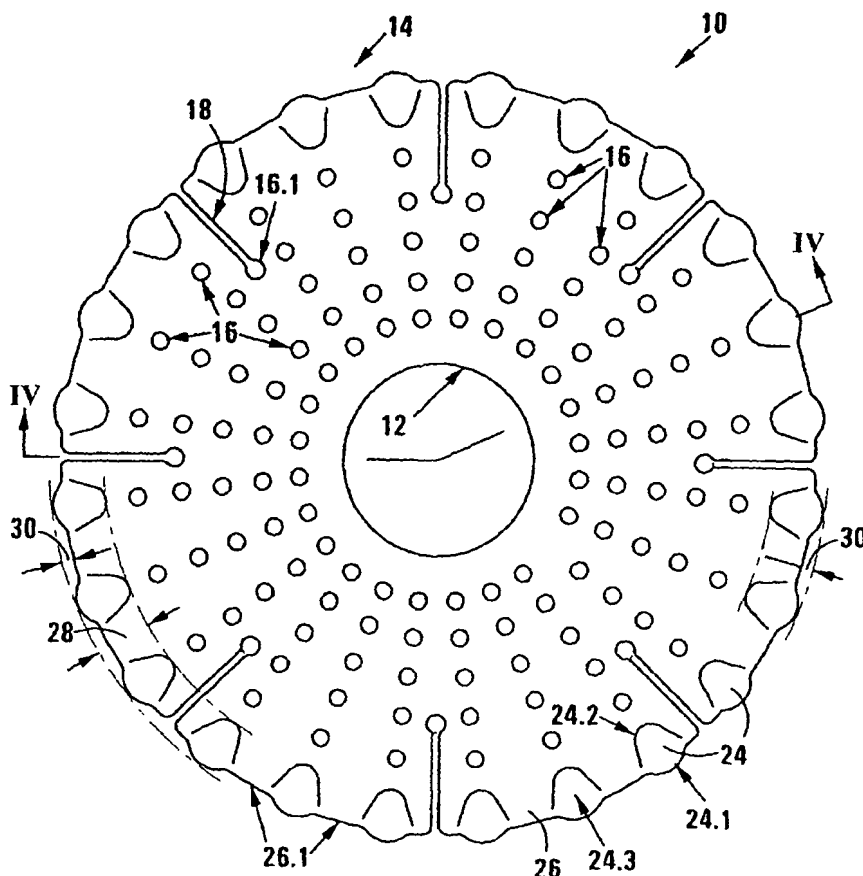
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(54) Title: A METHOD OF CLEANING A SUBMERGED SURFACE AND A SUCTION PAD



(57) Abstract: A suction pad 10 for an automatic pool cleaner has a general periphery, for example round. In a peripheral region 28 only, the pad 10 includes, intermittently in circumferential spacing, a plurality of raised formations 24 which, preferably, project radially outwardly beyond the general periphery. Edges of the formations may advantageously be undulating or scalloped to render the periphery wavy - both when seen in plan view and in side view. In use, the raised, projecting formations 24 can pass over and flexibly envelope obstacles such as debris, and irregularities of a submerged surface such as proud standing formations.



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## A METHOD OF CLEANING A SUBMERGED SURFACE AND A SUCTION PAD

THIS INVENTION relates to a method of cleaning a submerged surface, and to a suction pad for a pool cleaner.

5           The Applicant expects this invention to be particularly advantageously applicable to cleaning submerged surfaces of pools, especially swimming pools. That application will particularly be borne in mind for purposes of this specification.

10           Discs for automated swimming pool cleaners have all been essentially flexible, planar products which position themselves decumbently on a pool surface being cleaned. Discs frequently have various fins on the upper surface, perforations, grooves on the under surface and flutes. Examples of this art are shown in US patent 4 152 802 to Chauvier, US patent 5 421 054 to Dawson, US patent 5 433 15 985 to Atkinson and US patent 5 617 606 to Scott.

          Chauvier '802 describes a planar disc with a number of concertina-like circumferentially spaced folds in the outer perimetral region of the disc which make this region resiliently extensible. Dawson '054 describes fins on the periphery of the disc which fins have a radius 20 providing a smooth transition from the fins to the lower surface of the disc to facilitate unobstructed movement of the cleaner. Scot '606

describes a planar disc having two circumferentially spaced flutes creating direct paths from the periphery toward a mouth of the disc for debris laden fluid. Scott also discloses a raised lip between the flutes, which lip provide a ramped portion to facilitate negotiating obstacles often projecting from the interior pool surface.

In accordance with a first aspect of this invention, there is provided a method of cleaning a submerged surface including moving a flexible, generally planar, pad over the surface and applying suction to an underside of the pad, the method including causing a peripheral, raised formation or portion flanked by decumbent portions trailing the raised formation, of the pad, to approach an object or formation which is uneven with the submerged surface, and flexibly to pass over and at least partially to envelope the object or formation.

Intermittent portions only of the periphery may be raised, intermediate portions flanking the respective raised formation being flat or decumbent relative to the submerged surface. The raised portions then form openings for receiving or for receiving partially the object or formation, and thus assisting or causing the suction pad to pass over the object or formation.

Causing a respective intermittent formation which is raised to lead flanking intermittent portions which are flat, may be effected by having the raised formations projecting outwardly beyond the flat portions.

The method may include causing said peripheral formation in raised attitude to have an oblique edge relative to a direction of

advance of the pad. Thus, the method may include causing a resisting force, exerted on said oblique peripheral edge by a formation abutted by said oblique peripheral edge, to have a tangential component. Such tangential component tends either to induce the pad to rotate, or to induce the pool cleaner head to change direction, or both, any one of which is beneficial in counteracting the effect of the obstacle.

In accordance with a second aspect of this invention, there is provided a suction pad for a pool cleaner which suction pad is of flexible material and has a generally central aperture for connection to a pool cleaner and for having suction applied to an underside of the pad, the suction pad having a periphery and a peripheral border area which includes, alternatingly, flat portions and raised formations which raised formations project outwardly beyond the flat portions.

The periphery of the suction pad may be of generally curved shape, the raised formations having edges slanted relative to said general, curved shape of the periphery. Said edges may be convexly curved at a smaller curvature than the general curvature of the periphery.

The flat portions may be concavely curved relative to or may coincide with the general periphery. Thus, the raised formations and the flat portions may render the periphery of wavy shape when viewed in plan. Said wavy shape may be symmetrical.

Dimensions taken along the general periphery of the suction disc of the raised formations and of the flat portions may be equal within 50 %, preferably within 20 %.

The periphery of the suction pad may be wavy also when viewed along a general plane of the pad.

An outer lower edge of the periphery may be convexly chamfered or curved, so as not to be sharp.

5                   In accordance with a third aspect of this invention, there is provided a suction pad for a pool cleaner which suction pad is of flexible material and has a generally central aperture for connection to the pool cleaner and for having suction applied to an underside of the pad, the  
10                   suction pad having a peripheral border area including, alternately, at least 12 flat and at least 12 raised portions, preferably at least 16 flat and at least 16 raised portions, and most preferably 24 flat and 24 raised portions.

                  In accordance with a third aspect of this invention, there is provided a suction pad for a pool cleaner which suction pad is planar and  
15                   flexible, the pad having a shape which, in a peripheral region only of the pad, is selected from one of undulating and scalloped shape extending further radially outwardly than valleys of the shape, so presenting upwardly and outwardly inclined edge regions of the pad.

The shape of the periphery may be wavy.

20                   The invention is now described by way of example with reference to the accompanying diagrammatic drawings. In the drawings  
                  Figures 1 and 2 show respectively in top plan view and in bottom plan view a suction pad in accordance with the invention for a pool cleaner;

Figure 3 shows a side view of the suction pad; and

Figure 4 shows a section taken at IV-IV in Figure 1.

With reference to the drawings, a suction pad in accordance with the invention is in the form of a flexible disc generally indicated by reference numeral 10, having a generally, but not totally, round periphery 14. The deviation from a round shape is significant and will be described hereinafter. In other embodiments, merely a portion of the suction pad may be generally round, i.e. a leading portion may be generally round and may have the features or configuration described below, while a trailing portion may be of different design or construction.

The suction pad 10 has a central hole 12 by means of which it is mounted on or connected to a head of a pool cleaner and via which suction is applied to an underside of the suction disc 10 in use.

The suction disc 10 has a plurality of optional features which are known in the trade. A large plurality of apertures 16 is arranged generally in radial rows. A plurality of equally circumferentially spaced, radially oriented slots 18 are open ended at the periphery 14, extend radially inwardly only partially toward the hole 12, and terminate in apertures 16.1. As can be seen in Figure 2, in the bottom of the suction disc 10, grooves 20 extend from the apertures 16.1, as extensions of the slots 18, to positions only just shy of the periphery of the hole 12. In this embodiment, there are eight equally circumferentially spaced sets of slots 18, apertures 16.1 and grooves 20, which are all radially aligned.

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Intermediate the sets of slots 18, apertures 16.1 and grooves 20, there are provided grooves 22 in the bottom extending from positions just shy of the periphery 14 radially inwardly to positions just shy of the periphery of the hole 12. Two grooves 22 are angularly  
5 equally spaced between each pair of adjacent grooves 20.

In this embodiment, the radial rows formed by the apertures 16 are arranged intermediate adjacent grooves 22, or between a groove 20 and a groove 22 which are adjacent.

In accordance with the invention, the periphery 14, when  
10 seen in plan view such as in Figures 1 and 2, is of generally wavy shape comprising a plurality of radially outwardly extending, curved or wavy formations 24 projecting a distance 30 beyond a general periphery of the suction pad. Decumbent or flat portions 26 remain between the outwardly extending formations 24. The outwardly extending formations  
15 24 are confined to a peripheral band having a radial width or annular width 28. At their radially inner ends, the formations blend into the general plane of the suction disc 10 as shown at 24.2.

As can best be seen from Figures 3 and 4 in a view along a plane of the suction disc 10, the outwardly extending formations 24  
20 also project upwardly generally in the form of a halve-wave and form a corresponding plurality of hollows. Outer peripheral portions of the outwardly extending formations 24 are slanted from a decumbent line at an angle as indicated at 34. Thus, peripheral extremities 24.1 of the formations 24 are raised and lead edges 26.1 of the flat portions 26 in  
25 radial directions.



A lower outer edge of the suction disc 10 is convexly chamfered as indicated by reference numeral 32 in Figures 3 and 4.

In the embodiment shown, a diameter of the suction disc 10 is nominally four hundred and fifteen millimetre (415 mm). The radial  
5 width 28 is thirty millimetre (30 mm). The radial width falls within a range between 50 mm and 15 mm, advantageously between 40 mm and 20 mm.

The radial extent of the projection of the formations 24 beyond the general periphery, is 6 mm.

10 The angle 34 falls advantageously within a range between  $65^{\circ}$  and  $30^{\circ}$ , preferably between  $45^{\circ}$  and  $60^{\circ}$ , most preferably the angle is about  $55^{\circ}$ .

The high ridges 24.3 of the formations 24 rise above the general pane of the suction pad 10 by a distance of about 9 mm as  
15 shown at 36.

It is to be appreciated that, in other embodiments, the quantitative features may fall outside of the ranges given above, without departing from the qualitative features of the invention.

The Applicant does not wish to be bound by theory.  
20 However, the Applicant believes that an explanation of the mechanism by means of which the invention is believed to operate, will enhance a reader's understanding of the invention.

In pools, submerged surfaces are not always flat or regular. Frequently, formations exist deviating from the general surface, for example where fittings are not flush with the general surface, for example light fittings, pipe fittings, tiling, and the like. Such formations may stand proud of the surface, and in other cases a gap or groove may be formed in the general surface. It has been identified by the Applicant as a problem that suction discs known to the Applicant and having flat edges, or regularly curved or round peripheries, or being both flat and regularly curved or round, when abutting such formations cause the pool cleaner to be checked or stalled as the edge cannot surmount or has difficulty in surmounting the formation.

Another problem is that of dealing with unwanted matter such as grit, small stones or pebbles, twigs and the like which project above a general submerged surface. Frequently such objects are merely pushed along by a suction disc without surmounting them so as to subject them to suction.

In accordance with the invention, a large portion of the periphery (in the form of a plurality of intermittent portions) is raised. Furthermore, the raised formations project outwardly beyond the remaining decumbent or flat portions. Thus, as a pool cleaner advances toward an obstacle (proud standing formation, groove or gap, an obstacle having height, and the like) there is a good chance that a raised portion of the periphery will strike the obstacle first. By being raised and forming a hollow, it is believed that the raised formation will easily, or more easily than a decumbent portion, receive or partially receive the obstacle in the hollow and surmount the obstacle to move the disc over

## 9.

the obstacle, and in the case of unwanted matter, to subject the unwanted matter to the desired suction to clear it.

It is further to be appreciated that the projecting formations are curved or are more curved than a general periphery of the suction disc, thus, generally, presenting an oblique abutting surface causing an obstacle resisting advance of the disc to exert a force on the disc normal to the oblique surface i.e. having a radial and tangential component. The tangential component tends to rotate the disc relative to the cleaner head, or tends to direct the cleaner head away from its previous line of advance, or both. All these possibilities are conducive to prevent the disc from being trapped or checked against the obstacle.

The Applicant regards it as of prime importance that the suction disc 10 and especially the peripheral area, should be flexible and that stiffness should not be increased or should not be unduly increased by the provision of the raised formations.

It is also a requirement that the provision of the raised formations should not unduly influence the movement of the disc through water or the flow of water relative to the suction disc. It should also not unduly influence the effect of the apertures, slots and grooves described above. In the design in accordance with the invention, these objects are met. Thus, the features of the invention do not detract or do not unduly detract from normal operation of the suction disc along a regular or smooth submerged surface, and the features of the invention do assist in negotiating or surmounting obstacles as described above.

CLAIMS

1.           A method of cleaning a submerged surface including moving a flexible, generally planar, pad over the surface and applying suction to an underside of the pad, the method including causing a peripheral, raised formation flanked by decumbent portions trailing the raised formation, of the pad, to approach an object or formation which is uneven with the submerged surface, and flexibly to pass over and at least partially to envelope the object or formation.
2.           A method as claimed in claim 1 in which intermittent portions only of the periphery are raised, intermediate portions flanking the respective raised formations being decumbent relative to the submerged surface.
3.           A method as claimed in claim 2 in which causing a respective intermittent formation which is raised to lead flanking intermittent portions which are decumbent, is effected by having the raised formations projecting outwardly beyond the decumbent portions.
4.           A method as claimed in claim 3 which includes causing said peripheral formations in raised attitude to have an oblique edge relative to a direction of advance of the pad.
5.           A method as claimed in Claim 4 which includes causing a resisting force, exerted on said oblique peripheral edge by a formation abutted by said oblique peripheral edge, to have a tangential component.

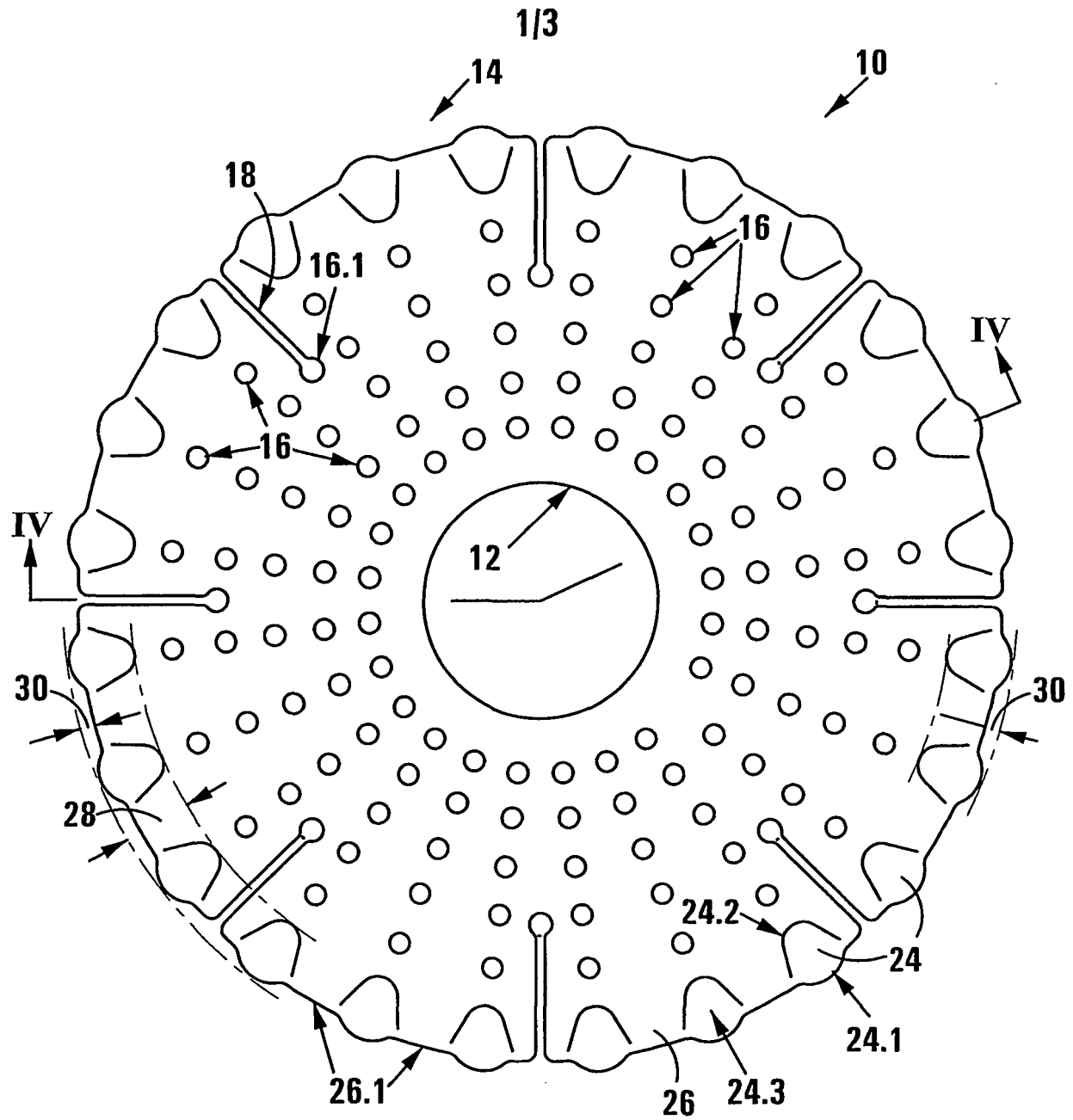
6. A suction pad for a pool cleaner which suction pad is of flexible material and has a generally central aperture for connection to a pool cleaner and for having suction applied to an underside of the pad, the suction pad having a periphery and a peripheral border area which includes, alternatingly, flat portions and raised formations which raised formations project outwardly beyond the flat portions.
7. A suction pad as claimed in claim 6 in which the periphery is of generally curved shape, and in which the raised formations have edges slanted relative to said general, curved shape of the periphery.
8. A suction pad as claimed in claim 7 in which said edges are convexly curved at a smaller curvature than the general curvature of the periphery.
9. A suction pad as claimed in claim 8 in which the flat portions coincide with the general periphery.
10. A suction pad as claimed in Claim 9 in which the raised formations and the flat portions render the periphery of wavy shape when viewed in plan.
11. A suction pad as claimed in claim 10 in which said wavy shape is symmetrical.
12. A suction pad as claimed in claim 11 in which dimensions taken along the general periphery of the suction disc of the raised formations and of the flat portions are equal within 20 %.

13. A suction pad as claimed in any one of claim 9 to claim 12 inclusive in which the periphery is wavy when viewed along a general plane of the pad.

14. A suction pad as claimed in any one of claim 6 to claim 13  
5 inclusive in which an outer lower edge of the periphery is convexly chamfered.

15. A suction pad for a pool cleaner which suction pad is of flexible material and has a generally central aperture for connection to the pool cleaner and for having suction applied to an underside of the  
10 pad, the suction pad having a peripheral border area including, alternately, at least 12 flat and at least 12 raised portions.

16. A suction pad for a pool cleaner which suction pad is planar and flexible, the pad having a shape which, in a peripheral region only of the pad, is selected from one of undulating and scalloped shape  
15 extending further radially outwardly than valleys of the shape, so presenting upwardly and outwardly inclined edge regions of the pad.



**FIG 1**

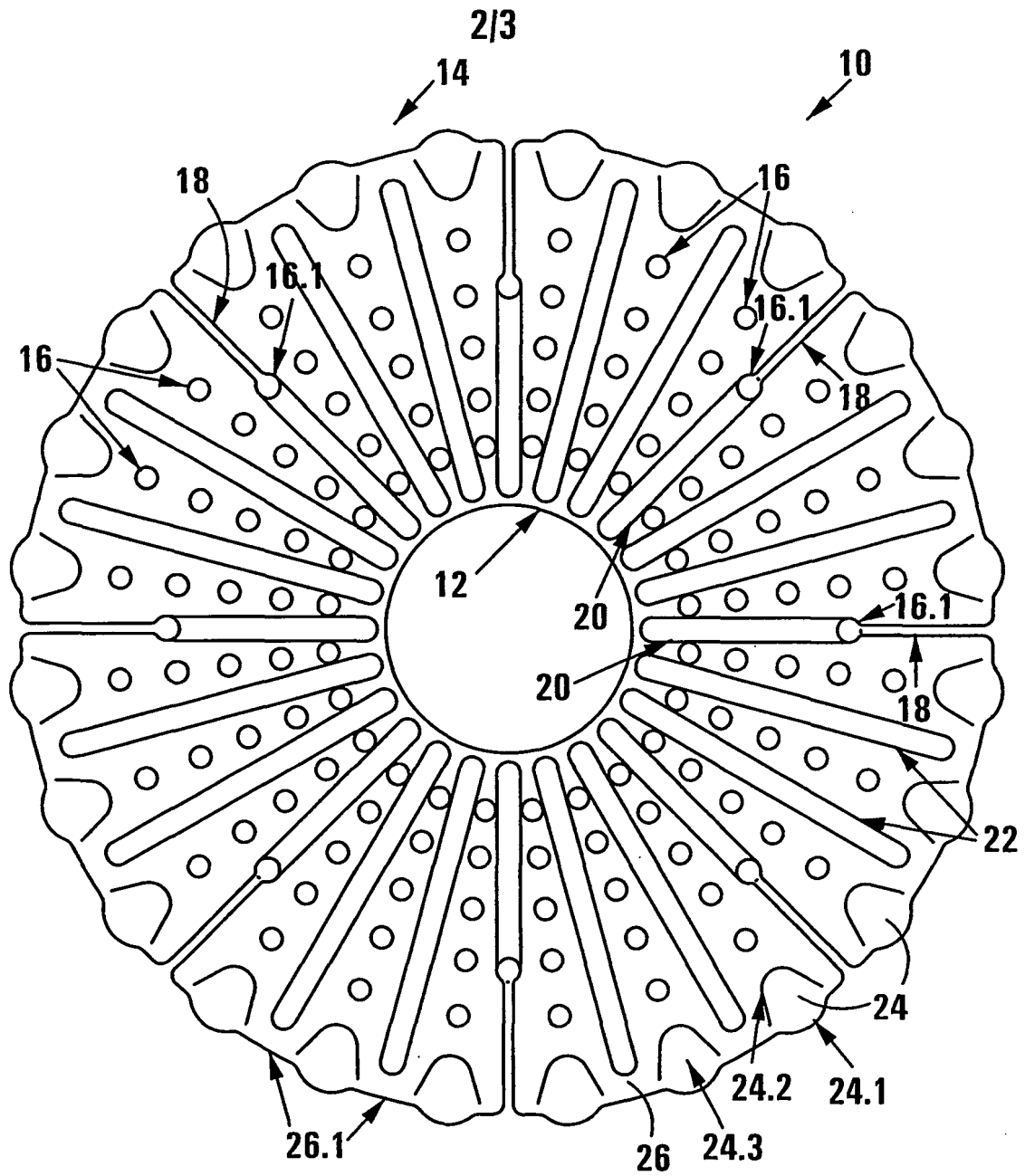


FIG 2



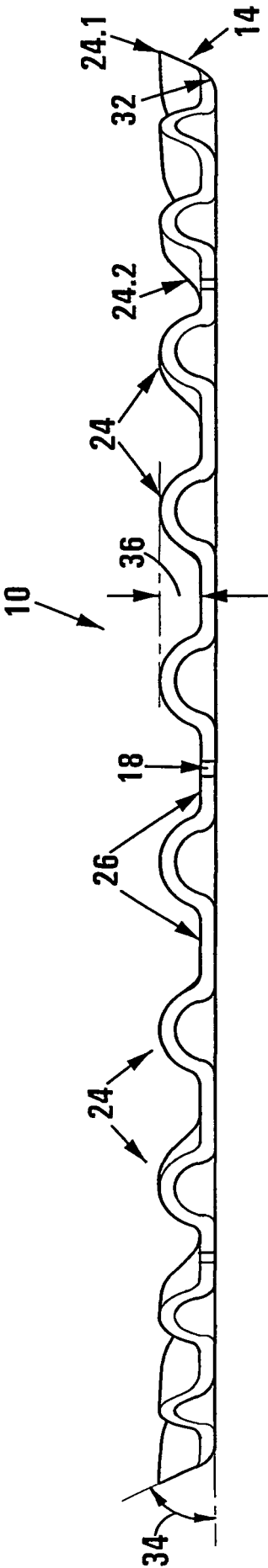


FIG 3

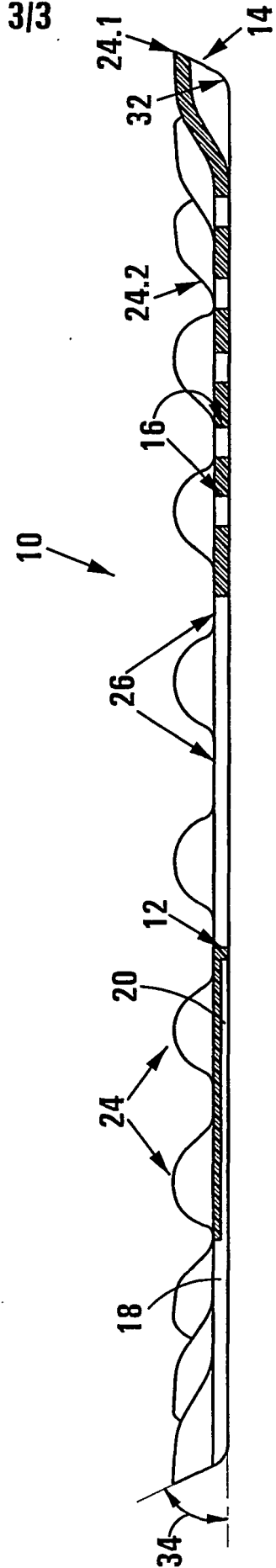


FIG 4

PCT/IB 01/01342

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 E04H4/16

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 E04H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 421 054 A (DAWSON ANDREW W ET AL) 6 June 1995 (1995-06-06) cited in the application	1-3, 6, 15
A	column 1, line 60 - column 2, line 1 column 3, line 19 - line 50; figures	16
X	WO 99 02803 A (DANIELA SEBOR FAMILY TRUST ; MOYRA A PHILLIPSON FAMILY TRUS (US)) 21 January 1999 (1999-01-21)	1, 2, 15
A	page 14, line 4-7; figures 6, 30	6, 16
A	US 5 617 606 A (CLARK WILLIAM T ET AL) 8 April 1997 (1997-04-08) cited in the application the whole document	1, 6, 15, 16



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

## \* Special categories of cited documents:

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\*G\* document member of the same patent family

Date of the actual completion of the international search

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